INSTRUCTIONAL TEACHING DESIGN (BRP)

PHYSICS OF MEASUREMENTS

by

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UNIVERSITY OF INDONESIA
FACULTY OF MATHEMATICS AND NATURAL SCIENCES
UNDERGRADUATE PHYSICS

INSTRUCTIONAL TEACHING DESIGN

Course Name	Physics of Measurements	**Credit(s)**	**Prerequisite Course(s)**	**Requisite Course(s)**	**Integration Between Other Courses**
Course Code	SCPH602258	2	Electronics 2	None	None
Course Branch	-				
Semester	3				
Lecturer(s)	Dr. Santoso S.				
Course Description	*Provide an overview of the basics of the measurement system; type of instrumentation and its characteristics; measurement of analog physical quantities: time dependent characteristics; calibration of sensors and measuring instruments; standard units and dimensions of measurement; measurement uncertainty; measurement reliability and security systems; signal conditioning; digital techniques in mechanical measurement; data reading and processing. This course will be taught in Indonesian.*				

Program Learning Outcome (PLO)	
PLO 1	Formulating problems and solving physics and its application, as well as interdisciplinary problems related to science and mathematics clusters critically, creatively, and innovatively.

PLO 2	Explaining the basic principles of experiments, applying the measurement methods of physics, and able to analyze the results correctly.
PLO 3	Applying the basic concepts of physics in the community and practical life,as well as identifying and adapting to new things.
PLO 4	Developing and deepening the knowledge gained in the bachelor degree program in a sustainable manner, and being able to continue to the master and doctoral education level.
Course Learning Outcomes (CLO)	
CLO 1	Students are able to design a good measurement instrument system that can measure physical quantities
Sub-CLO	
Sub-CLO 1	Able to apply learning methods.
Sub-CLO 2	Able to explain basics of physics of measurement.
Sub-CLO 3	Able to explain measurement system.
Sub-CLO 4	Able to explain types of instrumentation and its characteristics.
Sub-CLO 5	Able to explain time dependent characteristics.
Sub-CLO 6	Able to explain standard units and dimension of measured quantities.
Sub-CLO 7	Able to explain measurement uncertainties.
Sub-CLO 8	Able to explain measurement reliability and security systems.

Sub-CLO 9	Able to solve mid-term exam problems.
Sub-CLO 10	Able to explain signal conditioning.
Sub-CLO 11	Able to explain digital measurement.
Sub-CLO 12	Able to calibrate sensor and measurement instrument.
Sub-CLO 13	Able to measure analog physical quantities.
Sub-CLO 14	Able to read and process data.
Sub-CLO 15	Able to design measurement instrument device.
Sub-CLO 16	Able to solve final exam problems.
Study Materials	• Introduction to physics of measurement • Measurement system • Types of instruments and its characteristics • Time-dependent characteristics • Standard unit and dimension • Measurement uncertainties • Measurement reliability and security system • Signal conditioning • Digital measurement • Sensor and measurement instrument calibration • Analog quantities measurement • Data reading and processing • Measurement instrument system
References	1. Robert B. Northrop, Introduction to Instrumentation and Measurements, CRC Press, Taylor Francis Group, 2ed ,2005 2. Alan S Morsis, Measurement & Instrumentation Principles, Butterworth Heinemann, 3rd , 2001.

	3. J. G Webster, The Measurement, Instrumentation and Sensors Handbook, A CRC Handbook Published in Cooperation with IEEE Press, 1999 4. T. G. Beckwith, R. D. Marangoni, dan J. H. Lienhard V, Mechanical Measurements (I. Fundamentals of Mechanical Measurement, II. Applied Mechanical Measurements), Addison-Wesley Publishing Company, 5ed , 1993.

TEACHING PLAN

Week	Sub-CLOs	Study Materials [References]	Teaching Method [Time Required]	Teaching Modality	Learning Experiences		Sub-CLO Achievement Indicator	Sub-CLOs Weight on Course (%)
					Orientation; Exercise; Feedback		General Indicator; Specific Indicator	
					Online	Offline		
1	**Introduction to course**							
2	Sub-CLO 2	• Introduction to physics of measurement **[References]** [2] and [4]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (70%) **Feedback:** Question and answer (30%)		**General Indicator:** Able to understand various measurement instruments **Specific Indicator:** Able to choose the correct measurement instrument	7.5%
3	Sub-CLO 3	• Measurement system **[References]** [1]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to explain the standard of measurement	7.5%

4	Sub-CLO 4	• Types of instruments and its characteristics **[References]** [2] and [3]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to explain types of instrument	7.5%
5	Sub-CLO 5	• Time-dependent characteristics **[References]** [2], [3], and [4]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to use characteristics equation	7.5%
6	Sub-CLO 6	• Standard unit and dimension **[References]** [3] and [4]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:**	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to explain the standard units and dimensions	7.5%

					Question and answer (30%)			
7	Sub-CLO 7	• Measurement uncertainties **[References]** • [3]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to explain the normal and uniform distribution	7.5%
Mid-Term Exam								
9	Sub-CLO 9	• Measurement reliability and security system **[References]** [2]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to explain the principle of reliability	7.5%

10	Sub-CLO 10	• Signal conditioning **[References]** [1], [2], and [4]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to use noise reduction technique	7.5%
11	Sub-CLO 11	• Digital measurement **[References]** [1], [3], and [4]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to use sampling theorem and ADC or DAC	7.5%
12	Sub-CLO 12	• Sensor and measurement instrument calibraton **[References]** [2]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:**	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to explain the principle of calibration.	7.5%

					Question and answer (30%)			
13	Sub-CLO 13	• Analog quantities measuerment **[References]** • [3]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to measure distance, movement, and thickness.	7.5%
14	Sub-CLO 14	• Data reading and processing **[References]** • [2] and [4]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:** Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:** Able to show measured and recorded data signal.	7.5%
15	Sub-CLO 15	• Measurement instrument system **[References]** • [1]	Collaborative learning **[Time Required]** 100 minutes	**Syncronous** msTeams, Gmeet **Asyncronous** EMAS	**Orientation:** Introduction to topic (20%) **Exercise:**	**Exercise:** Working on presentation (25%)	**General Indicator:** Able to present the topics well **Specific Indicator:**	7.5%

					Topic discussion and presentation (25%) **Feedback:** Question and answer (30%)		Able to design a measurement instrument system	
Final Exam								

*) Syncronous: Teaching is done through real-time interaction between lecturer and student either through video conference or messaging. Asyncronous: Teaching is done through a forum or e-Learning system that don't need real time interaction and can be done in a span of days or weeks.

ASSIGNMENT DESIGN

Week	Assignment Name	Sub-CLO	Assignment	Scope	Working Procedure	Deadline	Outcome
1-16	Papers	1-16	Collaborative Scientific Writings	• All materials	Group assignment	1 semester	Article/Papers
1-16	Individual Assignment	1-16	Individual Report	• All materials	Individual Assignment	1 semester	Written report
1-16	Presentation	1-16	Group Presentation	• All materials	Group Assignment	1 semester	Presentation

ASSESMENT CRITERIA (LEARNING OUTCOME EVALUATION)

Evaluation Type	Sub-CLOs	Assessment Type	Frequency	Evaluation Weight (%)
Attendance	1-16	Attendance list	Each week	10
Papers Assignment	1-16	Written papers	1	10
Presentation	1-16	Group presentation	1	20
Individual Assignment	1-16	Individual report	3	10
Group Assignment	1-16	Group report	3	10
Mid-Term Exam	1-7	Answer sheet	1	20

Final Exam	9-15	Answer sheet	1	20
Total				**100**

Grading Criteria

Grading is based on University of Indonesia guideline.

Score Point	Grade	Weight
85—100	A	4,00
80—<85	A-	3,70
75—<80	B+	3,30
70—<75	B	3,00
65—<70	B-	2,70
60—<65	C+	2,30
55—<60	C	2,00
40—<55	D	1,00
<40	E	0,00

Assessment Rubric:

A. Criteria of Presentation

Score	Answer Quality
90-100	Students are able to apply basic concepts in explaining natural phenomena and technology with an accuracy of 80-90%, have a clear order, and appropriate wording.
70-89	Students are able to apply basic concepts in explaining natural phenomena and technology with an accuracy of 60-79% accuracy with appropriate wording.
60-69	Students are able to apply basic concepts in explaining natural phenomena and technology with an accuracy of 59% or less with appropriate wording.

B. Criteria of Mid-Term Exam and Final Exam

1) Able to write down their ideas and use it to solve a problem (25%);
2) Able to use the correct concept in solving the problem (35%);
3) Able to formulate the final result correctly (30%);
4) Able to use the appropriate dimension, units, and significant figures (10%);